MOLTEN ALKALI CARBONATE CELLS WITH GAS-DIFFUSION ELECTRODES*

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ABSTRACT

The application of gas-diffusion electrodes to high temperature fuel cells offers the possibility of obtaining the large current densities associated with such electrodes in low temperature cells. In addition the high internal resistance, electrolyte contamination and fragility encountered in the magnesia diaphragm cells are avoided. The problems which arise in connection with design and construction of gas-diffusion electrodes are control of pore size distribution and selection of materials.

An apparatus has been assembled to study the performance of small gas-diffusion electrodes immersed in a molten mixture of lithium, sodium and potassium carbonates. A reference electrode, consisting of a porous plug of gold sintered into a gold tube, permits study of the polarization characteristics of the individual electrodes. This is operated as an unloaded cathode (oxygen electrode). Gas-diffusion electrodes have been fabricated successfully using commercially available porous nickel and stainless steels and various sintered silver powders. Nickel shows very little polarization as a hydrogen electrode at temperatures above 500 C. Porous 431 stainless steel as a carbon monoxide electrode shows comparable polarization losses at 600 C. The data suggest that both the hydrogen and carbon monoxide electrodes suffer some activation polarization. In agreement with other workers we have found that silver makes an oxygen electrode showing negligible polarization above 600 C.

The cell assembly, although having large electrode separation, yields power densities at 600-650 C. comparable to those obtained from magnesia diaphragm cells operated at higher temperatures. It is anticipated that these will improve greatly when parallel close-spaced electrodes are used. No life tests have been carried out, but cells have been operated continuously for 100 hrs. Individual electrodes have operated without failure for several hundred hours. It appears that the operating life of electrodes will be limited by corrosion processes at the electrodes.

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